

***Rostanga byga* Er. Marcus, 1958 from Argentina: Redescription
and Comparison to *Rostanga pulchra* MacFarland, 1905
(Mollusca, Nudibranchia, Doridina)**

by

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Rostanga byga Marcus, 1958 is redescribed based on the examination of the type material and newly collected specimens from Golfo San José, Chubut, Argentina. The external coloration, radular morphology and reproductive system differ significantly from specimens of *Rostanga pulchra* MacFarland, 1905 collected from Monterey Bay, California (type locality), and examined for comparison. This latter species was probably recorded from Argentina (Camarones Bay, Chubut) as well. The geographic range of *R. byga* is extended from northern Brazil to Patagonia. *Rostanga pulchra* appears to have a disjunct geographic range in North and South America.

RESUMEN

Se redescrive la especie *Rostanga byga* Marcus, 1958 a partir del estudio del material tipo y de varios especímenes recolectados por primera vez en el Golfo San José, Chubut, Argentina. La coloración del cuerpo, morfología radular y sistema reproductivo difieren significativamente de especímenes de *Rostanga pulchra* MacFarland, 1905 recolectados en la localidad tipo, la Bahía de Monterey, California y examinados para su comparación. Probablemente, esta última especie ha sido también citada para Argentina (Bahía Camarones, Chubut). La distribución de *R. byga* se extiende desde el norte de Brasil hasta la Patagonia. *Rostanga pulchra* parece tener dos áreas de distribución disjuntas, en Norte y Sur América.

The genus *Rostanga* Bergh, 1879 comprises species of caryophyllidia-bearing dorids characterized by having short rhinophores with few lamellae, inner radular teeth folded inwards and outer teeth elongate and denticulate.

So far, two species of *Rostanga* have been reported from South America. Ernest Marcus (1958) described *Rostanga byga* based on a single, preserved specimen collected from the intertidal zone of Ilhabela, São Sebastião Island, Brazil. Later, Eveline Marcus (1970) extended the geographical range of this species to northern Brazil. Rudman and Avern (1989) revised the genus *Rostanga* from the Indo-West Pacific, and discussed other species of this genus described from all over the world. These authors recognized *R. byga* as a valid species, even though there was very little available information about it.

Ernest Marcus (1959) reported *Rostanga pulchra* MacFarland, 1905 from Chile, the first record of this species (originally described from California), from South America. Years later, Marcus and Marcus (1969) extended the geographic range of this species to Argentina, based on a single specimen collected at 102 m depth from Camarones Bay (Chubut). More recent records of *R. pulchra* from Chile (Schrödl 1996, 1997) confirmed the presence of this species in the southern Hemisphere. According to the published information, *R. pulchra* is known to have a disjunct geographic range in North and South America, with a large gap between the populations.

The present paper includes a complete anatomical study of several specimens of *Rostanga* collected from Argentina, and a comparison with material of *R. pulchra* from the type locality. In addition, the type material of *R. byga* is re-examined and compared to the original description.

The material examined is deposited at the Museo Argentino de Ciencias Naturales "Bernardino Rivadavia" (MACN), the Department of Invertebrate Zoology and Geology of the California Academy of Sciences (CASIZ), and the American Museum of Natural History (AMNH).

SPECIES DESCRIPTIONS

Family Rostangidae Pruvot-Fol, 1951

Genus *Rostanga* Bergh, 1879

***Rostanga pulchra* MacFarland, 1905**

Figs. 1, 2, 3A

Rostanga pulchra MacFarland, 1905:40–41; 1906:119–122, pl. 24, fig. 8, pl. 18, figs. 18–21, pl. 21, fig. 109; 1966:165–169, pl. 25, fig. 7, pl. 29, figs. 7–10, pl. 35, figs. 1–16; Er. Marcus, 1959:35–37, 106, figs. 65–68; Er. Marcus, 1961:15, pl. 3, figs. 46–49; Marcus and Marcus, 1969:20–21; Marcus and Marcus, 1970:202–203; Thompson, 1975:489; Rudman and Avern, 1989:330; Schrödl, 1996:22; Schrödl, 1997:38–42.

MATERIAL EXAMINED. — Monterey Bay, California, 17 August 1978, three specimens 11, 12 and 16 mm preserved length, collected by G. McDonald (CASIZ 069163); 24 August 1978, three specimens 14, 15 and 18 mm preserved length, collected by G. McDonald (CASIZ 070734).

EXTERNAL MORPHOLOGY. — The body shape is oval, somewhat elevated. The dorsum is covered with cup-shaped caryophyllidia, about 150 μ m long. The rhinophoral and branchial sheaths are also surrounded by caryophyllidia. Each caryophyllidium consists of an extremely small, rounded, ciliated tubercle with small marginal cilia and 4–5, taller, thin spicules surrounding the tubercle. The living animals (Fig. 1) vary from orange-yellow to bright red in color. Some specimens may have small, brown spots scattered on the dorsum. The mantle margin is surrounded by small, white spots. The perfoliate rhinophores have the same color as the dorsum and are composed of 9 vertical, transverse lamellae. The gill has the same color as the rest of the body, and is composed of 6–10 bipinnate branchial leaves. The anal papilla lies within the circlet of the branchial plume.

Ventrally, the anterior border of the foot is bilabiate and notched. The foot is wide relative to the mantle margin. The oral tentacles are well formed, and appear conical in shape.

INTERNAL ANATOMY. — The radular formula is $50 \times 48.0.48$ in a 16 mm preserved length specimen (CASIZ 069163) and $53 \times 51.0.51$ in an 18 mm preserved length specimen (CASIZ 070734). The innermost lateral teeth are the shortest of the row. They are thin, folded inwards, and have 6–8 denticles on the inner side of the short cusp (Fig. 2A). The lateral teeth change gradually in size from the inner to mid-lateral. The mid-lateral teeth are wide, having a long, pointed, primary cusp and a large secondary cusp situated near the base (Fig. 2B). The outer lateral teeth are very thin and elongate, with a fine brush of 9–10 denticles at the end (Fig. 2C, D). The jaws are solid, with few rodlets of varying length (Fig. 2E).

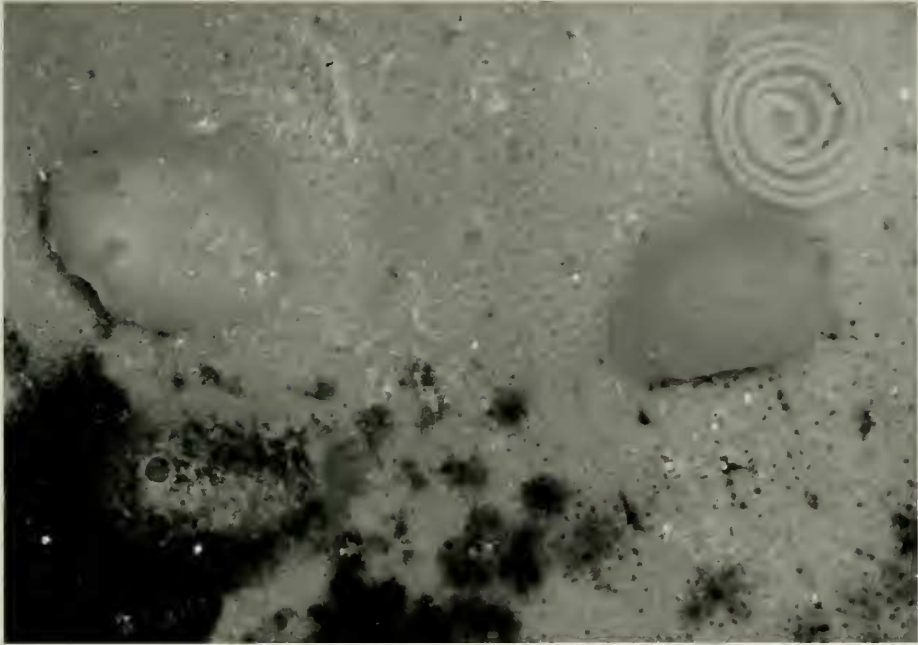


FIGURE 1. *Rostanga pulchra* MacFarland, 1905, living animals from Monterey Bay, showing color variation and an egg mass. Photograph by Robert Ames (CASIZ photo collection).

In the reproductive system the ampulla is wide and short. It narrows before branching into the oviduct, which enters the female gland, and the large prostate (Fig. 3A). The prostate is flat and massive, and has two well-differentiated portions. The prostate narrows and forms the proximal end of the deferent duct. The distal end of the deferent duct is very long. The penis has no armature. The deferent duct and vaginal duct meet at a common atrium. The vaginal duct is very long and narrows before opening into the large, oval bursa copulatrix. At some distance from the vaginal duct insertion, another long duct leads from the bursa copulatrix and connects to the seminal receptacle and the uterine duct. The seminal receptacle is small and oval, with a slightly pointed end opposite its short stalk.

GEOGRAPHIC RANGE. — This species is known from Alaska (Lee and Foster 1985) to Mexico (Marcus and Marcus 1970) in the Northern Hemisphere, and from Chile (Ernest Marcus 1959; Schrödl 1996, 1997) to Argentina (Marcus and Marcus 1969) in the Southern Hemisphere.

Rostanga byga Er. Marcus, 1958
Figs. 3B, 4–6

Rostanga byga Er. Marcus, 1958:22–25, figs. 34–36; Ev. Marcus, 1970:943; Rudman and Avem, 1989:329.
Rostanga cf. *pulchra* (MacFarland): Muniain, 1997:21

MATERIAL EXAMINED. — **HOLOTYPE:** Ilhabela, São Sebastião Island, Brazil, June 1956, one specimen 11 mm preserved length, collected under a stone in the intertidal zone (AMNH 3507). Golfo San José, Chubut, Argentina, November, 1991, one specimen 12 mm preserved length (CASIZ 118014) and one specimen 14 mm preserved length (MACN 34174) collected by C. Muniain; April 1998, one specimen 20 mm long, collected by C. Muniain.

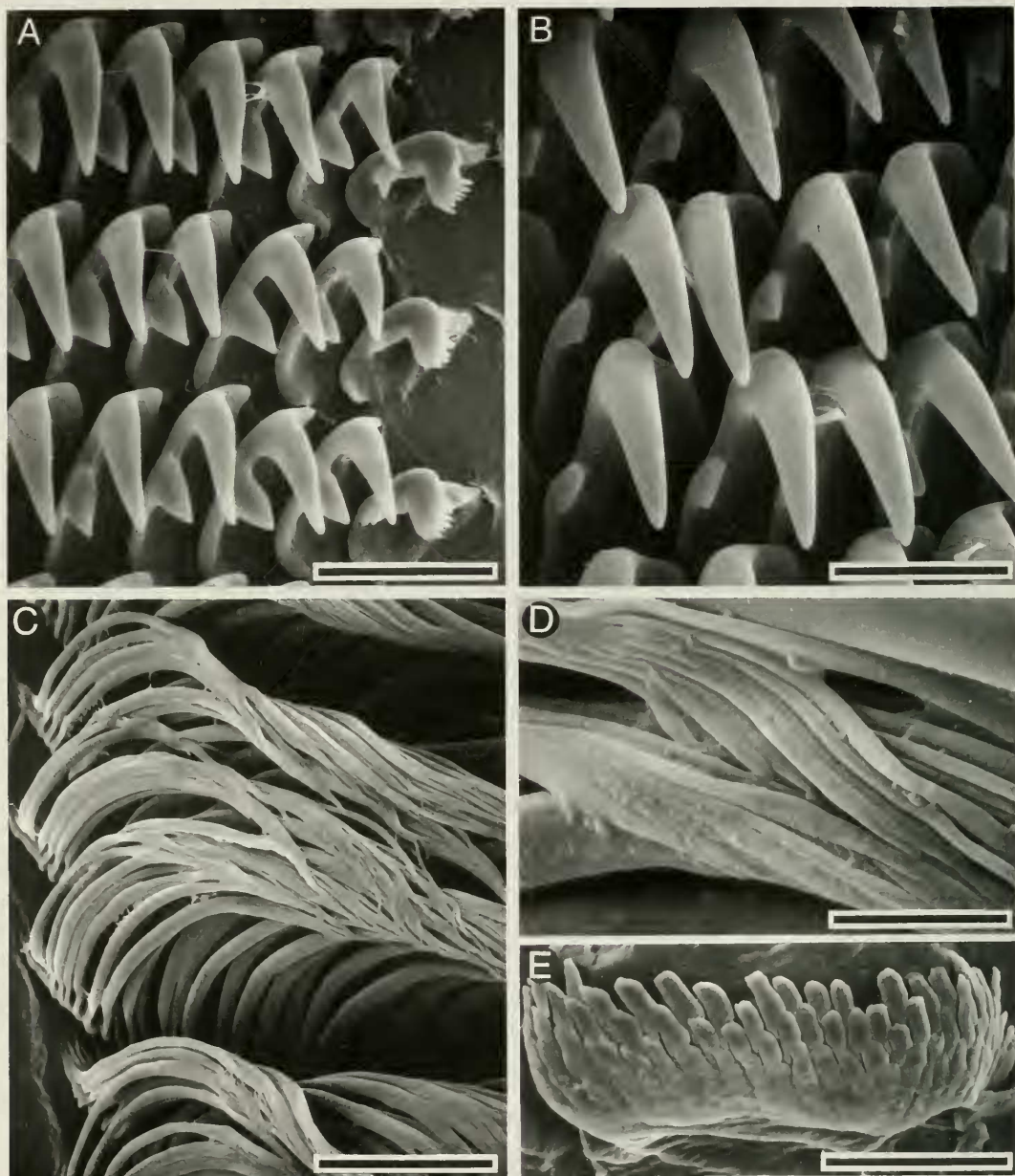


FIGURE 2. *Rostanga pulchra* MacFarland, 1905, scanning electron micrographs (CASIZ 070734). A. Inner lateral teeth, scale = 25 μ m; B. Mid-lateral teeth, scale = 30 μ m; C. Outer lateral teeth, scale = 60 μ m; D. Detail of the outermost teeth denticulation, scale = 7.5 μ m; E. Jaw, scale = 60 μ m.

EXTERNAL MORPHOLOGY. — The body shape is oval and somewhat elevated (Figs. 4A, 5). The surface of the mantle is densely covered with caryophyllidia about 100 μ m long. The rhinophoral and branchial sheaths are also surrounded by caryophyllidia. Each caryophyllidium consists of a large, rounded ciliated tubercle, with small marginal cilia and 6 spicules surrounding the tubercle. The ground color of the mantle is orange in the living animals, lightly spotted with white dots in the middle

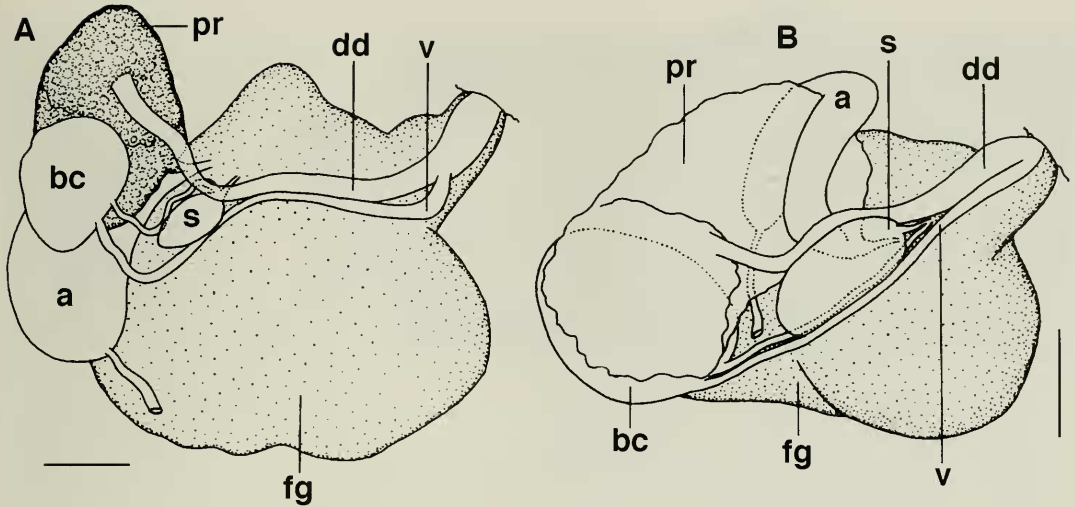


FIGURE 3. Reproductive systems. A. *Rostanga pulchra* MacFarland, 1905 (CASIZ 070734); B. *Rostanga byga* Er. Marcus, 1958 (CASIZ 118014). Abbreviations: a, ampulla; bc, bursa copulatrix; dd, deferent duct; fg, female gland; pr, prostate; s, seminal receptacle; v, vagina.

of the dorsum and between tubercles. The perfoliate rhinophores are pale orange with translucent tips, and are composed of 14–16 vertical, transverse lamellae (Fig. 4B). The gill has the same color as the dorsum, and is composed of 10 short, simply pinnate, branchial leaves. The anal papilla lies within the circlet of the branchial plume. Ventrally, the anterior border of the foot is notched and grooved (Fig. 4C). The foot is completely orange, and narrow relative to the mantle margin. The oral tentacles are digitiform.

INTERNAL ANATOMY. — The radular formula is $45 \times 53.0,53$ in a 12 mm preserved length specimen (CASIZ 118014) and $58 \times 55.0,55$ in a 14 mm preserved length specimen (MACN 34174). The innermost lateral teeth are the shortest of the row. They have a rounded, long cusp with 7–10 short denticles on the inner edge (Fig. 6A). The lateral teeth change gradually in size from the inner to mid-lateral. The mid-lateral teeth have a broad triangular base and a pointed primary cusp (Fig. 6B). These teeth lack a secondary cusp, but have a small lateral wing near the base. The outermost lateral teeth are very thin and elongate, having a fine brush of 6–10 denticles at the end (Fig. 6C, D). The jaws are very small, having few irregular rodlets of varying shape and length (Fig. 6E).

In the reproductive system the ampulla is thin and long. It narrows before branching into the oviduct, which enters the female gland, and the prostate (Fig. 3B). The prostate is flat and very large. It has two well-differentiated portions. In one of them the deferent duct leaves as a narrow long duct. The penis has no armature. The deferent duct and vaginal duct meet at a common atrium. The vaginal duct opens into the large, oval, bursa copulatrix. Next to the opening of the vaginal duct leads another duct, which connects to the seminal receptacle and the uterine duct. The seminal receptacle is oval and conspicuous.

GEOGRAPHIC RANGE. — This species is known from the southwest Atlantic, from the North of Brazil to Argentina (Chubut).

DISCUSSION

The Argentinean specimens of *Rostanga* examined in this paper clearly belong to *R. byga*. The holotype of *R. byga* was dissected when it was originally examined, and the radula and reproductive system were missing. However, there is enough information in the original description (Ernest

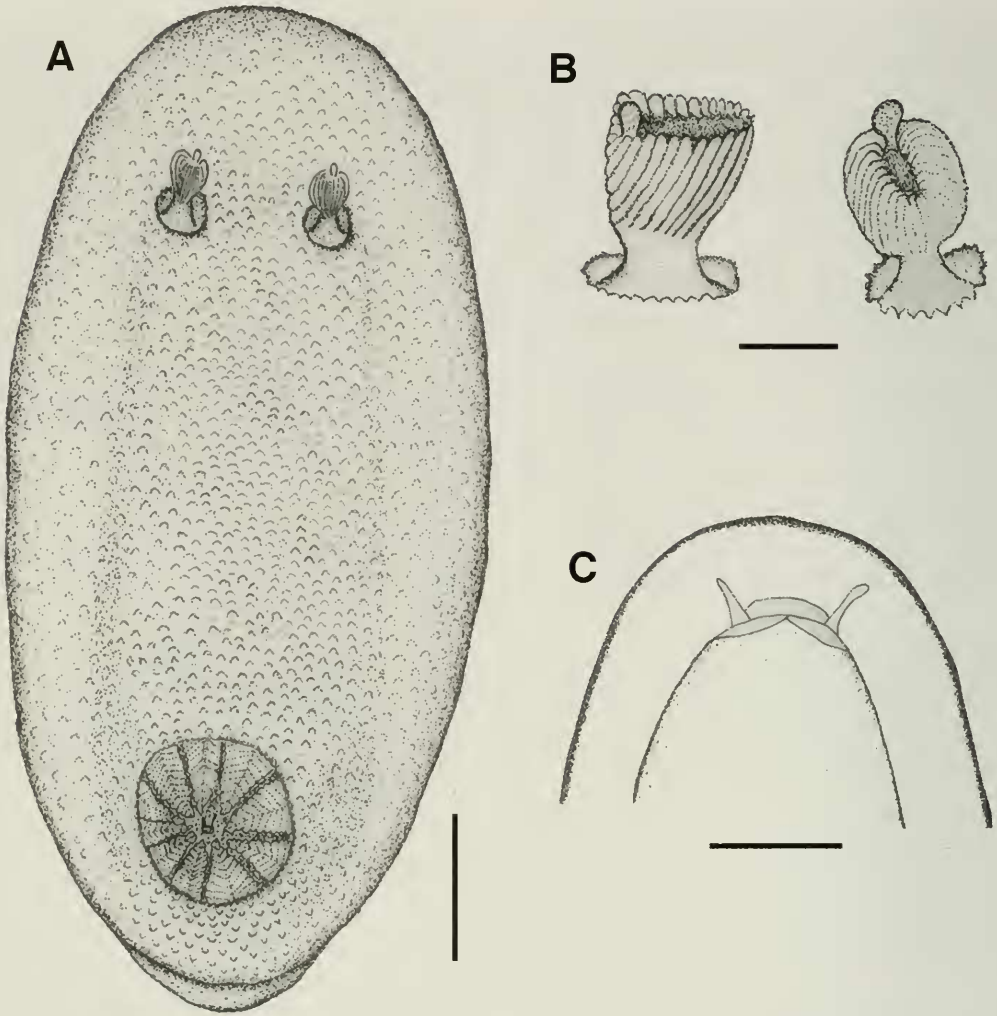


FIGURE 4. *Rostanga byga* Er. Marcus, 1958 (MACN 34174). A. Living animal, scale = 3 mm; B. Lateral and overview of the rhinophores, scale = 2.5 mm; C. Ventral view of the anterior border of foot, scale = 4.5 mm.

Marcus 1958), to compare our specimens with *R. byga*. According to Ernest Marcus (1958), *R. byga* is a bright, brick red species with dorsal white spots. Our specimens from Argentina have a similar coloration, with very distinctive white dots on the dorsum. Anatomically, in *R. byga* the innermost lateral teeth have a long cusp, longer than the base, and the lateral teeth lack a secondary cusp. Also, in the reproductive system drawn by Ernest Marcus (1958) for *R. byga*, the ducts leading from the bursa copulatrix are next to each other, the prostate is large and the ampulla is elongated. All of these characteristics, which are diagnostic of *R. byga*, are present in our specimens.

Based on the examination of several specimens of *R. pulchra* from California and *R. byga* from Argentina, it is clear that they constitute two distinct species (see Table 1). Externally, *R. byga* is an orange species with white spots on the dorsum, whereas *R. pulchra* varies from orange to bright red, sometimes having black or brown dorsal spots. Also, *R. byga* has twice as many lamellae in the rhinophores as *R. pulchra*. In addition, the caryophyllidia of *R. pulchra* have a small ciliated tubercle, whereas it is very large in *R. byga*. Internally, the innermost lateral teeth of *R. pulchra* have a short

cusps, with long denticles, whereas in *R. byga* the cusp of the innermost teeth is longer, with shorter denticles. The mid-lateral teeth of *R. pulchra* have a large, secondary cusp situated under the main cusp, whereas this secondary cusp is very small in *R. byga*. The jaws of *R. pulchra* have several elements regularly arranged, whereas in *R. byga* the jaws are very reduced, with only a few, irregular elements. The ampulla of *R. pulchra* is comparatively shorter and wider than that of *R. byga*, and the prostate of *R. pulchra* appears to be smaller. In addition, the two ducts emerging from the bursa copulatrix of *R. pulchra* are separated, whereas they are next to each other in *R. byga*.

The other Atlantic species of *Rostanga* is *Rostanga rubra* (Risso, 1818) from the northeast Atlantic. This species is clearly distinguishable from *R. pulchra* and *R. rubra* by the presence of very wide inner lateral teeth, with strong denticles, and elongate outermost teeth with a single denticle (Thompson and Brown 1984). This is very different from both *R. pulchra* and *R. byga* that have narrower inner teeth and outer teeth with numerous denticles.

The present record of *R. byga* constitutes the first account of this species from the temperate waters of the Argentinean biogeographic Province, near the limit with the Magellanic Province. Records of the genus *Rostanga* from the Magellanic Province have been assigned to *R. pulchra* (Ernest Marcus 1959; Marcus and Marcus 1969; Schrödl 1996, 1997). The first of them (Ernest Marcus 1959), includes a complete anatomical description of the specimens collected from Chile. According to this description, there is no question that the specimens studied belong to *R. pulchra*. The morphology of the radula, with a short cusp on the innermost lateral teeth and a large secondary cusp on the mid-lateral teeth is characteristic of this species. The other records from Chile (Marcus and Marcus 1969; Schrödl 1996, 1997), include brief descriptions without anatomical information, and it is difficult to determine the identity of the animals studied. The record from Argentina (Marcus and Marcus 1969) is particularly problematic, not only because it is based on a single preserved specimen, but also because it was collected from a locality very close to the limit between the Magellanic and Argentinean Provinces. According to Marcus and Marcus (1969), the specimen was collected at 102 m depth, and had a very large radular formula ($85 \times 90.0.90$), larger than that of either *R. pulchra* or *R. byga*. The animal was preserved, so there was no information available on the external coloration. However, Marcus and Marcus (1969) indicated that there were several dark spots on the dorsum of the preserved animal, which is characteristic of *R. pulchra*. With the available information we can not determine the identity of this specimen, but it is very likely that it belongs to *R. pulchra*.

The record of *Rostanga byga* from Northern Chubut is very close to the southern boundary of the Argentinean biogeographic Province with the cold waters of the Magellanic Province. According to Carcelles and Williamson (1951), this boundary is situated in Golfo Nuevo, about $42^{\circ}30'S$. However, it is not unusual to find warm-water species of opisthobranch mollusks in this transitional area. Other temperate or warm-water species with a similar distributional pattern to *R. byga* have been recently studied from Argentina (see Muniain 1997; Muniain and Ortea 1998; Muniain and Ortea, in press). On the other hand, Carcelles and Williamson (1951) and Muniain (1997), showed that the Magellanic

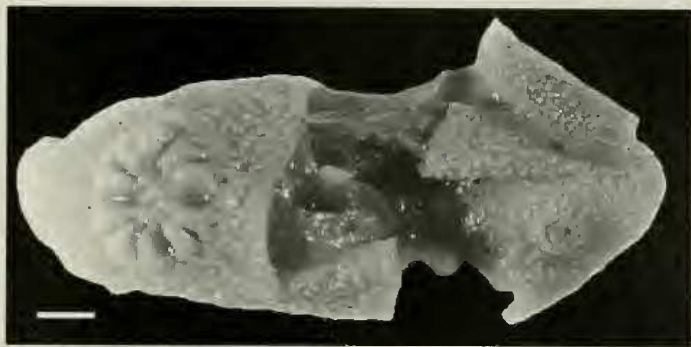


FIGURE 5. *Rostanga byga* Er. Marcus, 1958, holotype (AMNH 3507).

TABLE 1. Comparative morphology of *Rostanga pulchra* and *R. byga*.

Species	References	Radular formulae	Innermost tooth denticles	Length	Coloration	Locality
<i>Rostanga pulchra</i> MacFarland, 1905	MacFarland 1906	60 × 50–60.0.50–60	8–11	18 mm (alive)	Bright red, varying from light yellow-red to deep scarlet, with brown and black spots on the back.	Monterey Bay, CA
	MacFarland 1966	68–80 × 81.0.81	8–11	8–12 mm (alive)		Crescent City, CA
	Ev. Marcus and Er. Marcus 1969	85 × 90.0.90	3–5	9 mm (preserved)	?	Camarones Bay, Argentina
	Thompson 1975	69 × 53.0.53	?	15 mm (preserved)	?	Lopez Island, WA
	Present paper	50 × 48.0.48	6–8	16 mm (preserved)	Orange-yellow to bright red; brown spots scat- tered on the dorsum, white spots on the mantle margin.	Monterey Bay, CA
Present paper	53 × 51.0.51	6–8	18 mm (preserved)	Monterey Bay, CA		
<i>Rostanga byga</i> Er. Marcus, 1958	Er. Marcus 1958	60 × 60.0.60	5–8	11 mm (preserved)	Bright brick red, with white dots on some dor- sal papillae.	Ilhabela, Brazil
	Present paper	45 × 53.0.53	7–10	12 mm (preserved)	Orange, lightly spotted with white dots on the middle of the dorsum.	Golfo San José, Argentina
	Present paper	58 × 55.0.55	7–10	14 mm (preserved)		Golfo San José, Argentina
	Present paper	62 × 62.0.62	7–10	20 mm (alive)		Golfo San José, Argentina

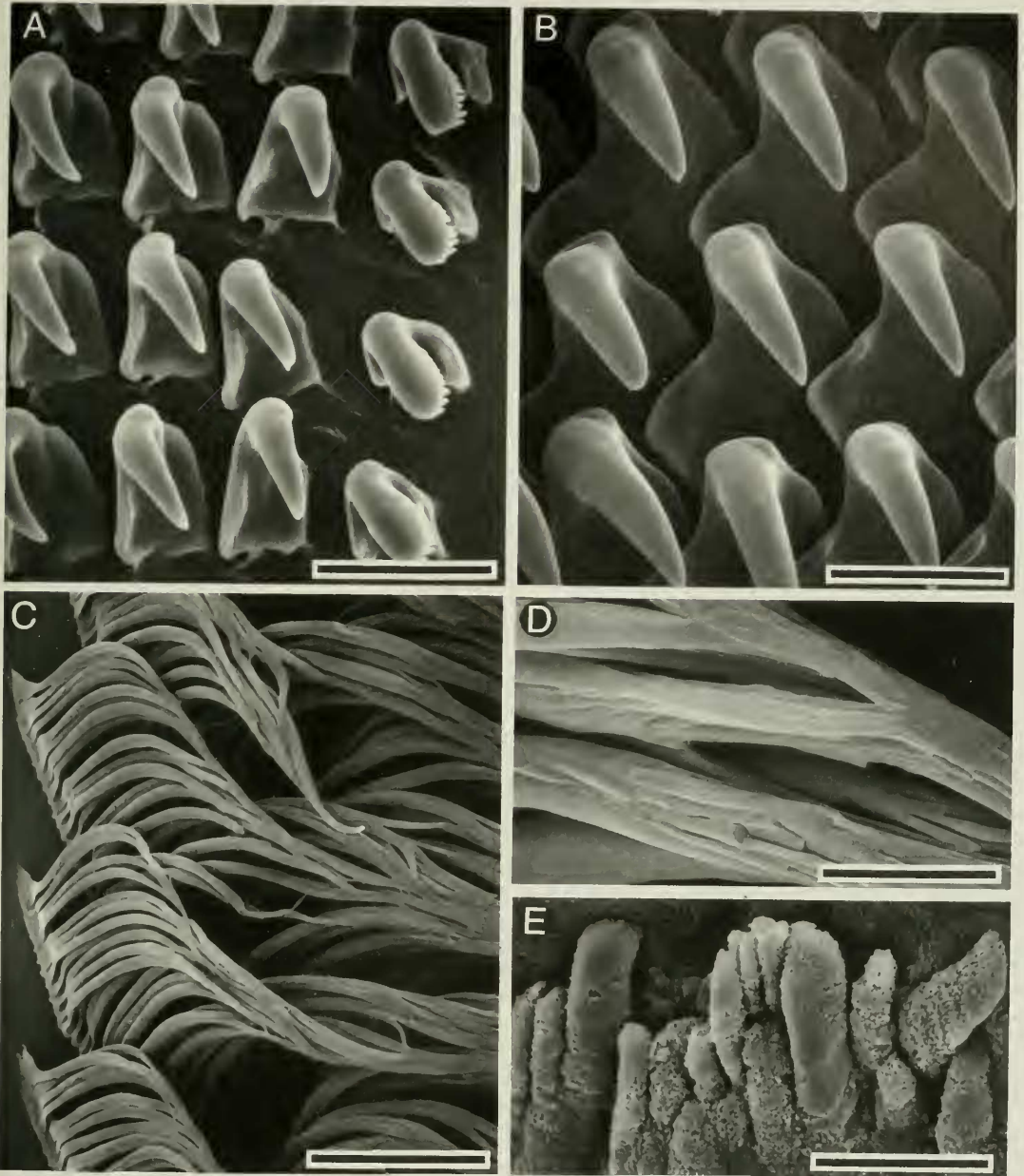


FIGURE 6. *Rostanga byga* Er. Marcus, 1958, scanning electron micrographs (CASIZ I18014). A. Inner lateral teeth, scale = 30 μm ; B. Mid-lateral teeth, scale = 43 μm ; C. Outer lateral teeth, scale = 75 μm ; D. Detail of the outermost teeth denticulation, scale = 10 μm ; E. Jaw, scale = 15 μm .

species collected from Northern Chubut to Río de la Plata (Argentinean Province) always occur in deeper and colder waters (100–200 m). This phenomenon is probably related to a northern extension of the Falklands Current in deeper waters (Carcelles and Williamson 1951; Muniain 1997). The fact that the specimen of *R. pulchra* reported by Marcus and Marcus (1969) from this area was collected from deep (102 m), and therefore colder waters, seems to support this hypothesis.

ACKNOWLEDGMENTS

The authors would like to recognize the support of several individuals. Terry Gosliner allowed us to study material of the California Academy of Sciences and reviewed the manuscript. James Cordeiro and Paula Mikkelsen (American Museum of Natural History), provided us with the type material of *Rostanga byga*, which was photographed at the Photography Department of the Museo Argentino de Ciencias Naturales. Dong Lin, Photography Department of the California Academy of Sciences, printed the scanning electron micrographs.

This paper has been supported in part by the Fundación Antorchas and Conicet, through a research subsidy and a postdoctoral fellowship to the first author, the Ministerio de Educación y Cultura of Spain (SEUI), through a postdoctoral fellowship to the second author, and the California Academy of Sciences.

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